Exploration Augmentation Module Project

Canceled Technology Project (2013 - 2015)

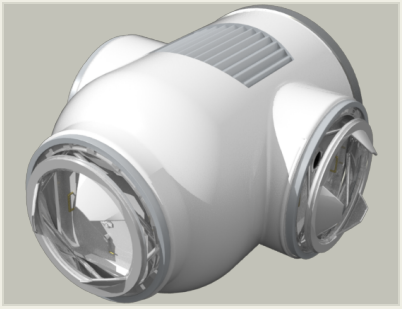
Project Introduction

The Exploration Augmentation Module (EAM) project goal is to design and deliver a flight module that is to be deployed to Earth-Lunar Distant Retrograde Orbit (DRO). The EAM Project will, as a minimum, define, mature, and plan an implementation approach that will develop a 30-60 day crew habitat capability, airlock, and advanced EVA capabilities, and support deep space research that addresses these varied environmental and mission needs. This project was canceled for budgetary reasons.

The EAM project goal is to design and deliver a flight module that is to be deployed to Earth-Lunar Distant Retrograde Orbit (DRO). At this location it will perform several functions: 1) perform deep-space research and exploration systems testing, 2) dock with the Asteroid Redirect Vehicle (ARV) and enable 30-to-60-day crewed asteroid utilization missions, and 3) serve as a deep space port for future deep space missions. The EAM may be launched first to ISS or to lunar DRO as early as FY2020 to support research needed for future deep space missions as well as to extend crew size, exploration functions and mission durations for the asteroid redirect mission. Acting as a deep space port, the EAM may be mated with an additional pressurized habitation module as early as the year 2028, as an augmentation for conducting possible longer duration missions in Earth-Lunar space or to Mars. Therefore, the EAM Project will, as a minimum, define, mature, and plan an implementation approach by the end of FY2014 that will develop a 30-60-crew habitat capability, airlock, and advanced EVA capabilities, and support deep space research that addresses these varied environmental and mission needs.

The EAM project end product will possibly include the delivery of the EAM protoflight module for launch in the FY2019 time frame, as well as the flight planning and hardware to accommodate the progressive in-orbit build-up and modifications that will support the exploration capability demonstrations (possibly on ISS), the 30-to-60-day Asteroid Utilization Missions, and the augmented long-duration deep space configurations to support either extended Earth-Lunar missions or deep space excursions such as missions to Mars. The EAM configuration is still under assessment. The major functions of the EAM are to provide habitation for 30-60 days for a crew of four in deep space docked with the Orion spacecraft; provide EVA capability; provide capability for testing exploration systems (Environmental Controll and Life Support Systems, long duration food storage, radiation mitigation, teleoperations of robotic systems, spacecraft autonomy, etc.) in deep space; provide for exploration of redirected asteroid into DRO, including sample curation and emplacement of instrument;, and to provide a first foothold in deep space for future exploration missions including docking ports for visiting vehicles.

NASA's Advanced Exploration Systems (AES) is pioneering new approaches for rapidly developing prototype systems, demonstrating key capabilities, and validating operational concepts for future human missions beyond Earth orbit.



Conceptual Model of the Exploration Augmentation Module (EAM)

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AES activities are uniquely related to crew safety and mission operations in deep space, and are strongly coupled to future vehicle development. Early integration and testing of prototype systems reduces risk and improves affordability of exploration mission elements. The prototype systems developed in AES are to be demonstrated in ground-based test-beds, field tests, and in-flight experiments. In addition to developing building blocks for future missions, AES explores innovative ways to drive a rapid pace of progress, streamline project management, and use limited resources and the NASA workforce more effectively.

For its education and public outreach goal, the EAM project directly contributes to the development of the sciences, technologies, engineering and math (STEM) workforce in disciplines needed to achieve NASA's strategic goals. The eXploration Habitat (X-Hab) academic innovation challenge is a university-level challenge designed to engage and retain students in STEM, as well as to train and develop the STEM workforce of the future needed to implement U.S. space exploration policy.

Anticipated Benefits

An EAM system is a technically greater challenge than ISS in the areas of logistics, radiation, communications, autonomous systems, storage & disposal, and volume utilization. Advancing the state-of-the-art to meet EAM project objectives will make available enhancing technologies for ISS as well.

An EAM system could be enhanced to enable other NASA unfunded and planned missions, such as the Asteroid Redirect Mission (ARM), by providing an asset that would improve performance for these missions.

The development of EAM systems technologies in cis-lunar space offers an incremental extension of the business opportunities for commercial space at ISS -- especially with respect to commercial cargo.

Organizational Responsibility

Responsible Mission Directorate:

Exploration Systems Development Mission Directorate (ESDMD)

Lead Center / Facility:

Johnson Space Center (JSC)

Responsible Program:

Exploration Capabilities

Project Management

Program Director:

Christopher L Moore

Project Manager:

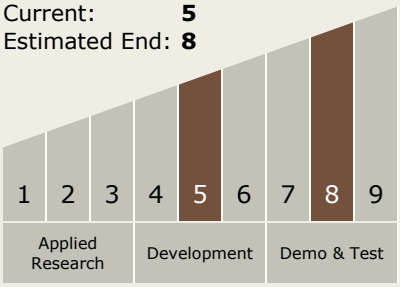
Lora J Bailey

Principal Investigator:

Lora J Bailey

Technology Maturity (TRL)

Start: **5**
Current: **5**
Estimated End: **8**



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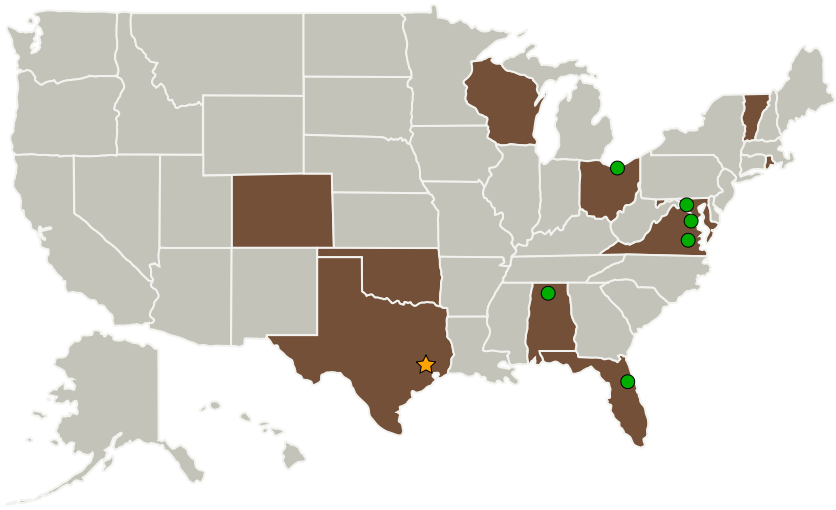
Primary U.S. Work Locations and Key Partners



Technology Areas

Primary:

- TX07 Exploration Destination Systems
  - TX07.2 Mission Infrastructure, Sustainability, and Supportability
    - TX07.2.1 Logistics Management

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Organizations Performing Work	Role	Type	Location
★Johnson Space Center(JSC)	Lead Organization	NASA Center	Houston, Texas
●Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio
●Goddard Space Flight Center(GSFC)	Supporting Organization	NASA Center	Greenbelt, Maryland
Jacobs Engineering Group, Inc.	Supporting Organization	Industry	Dallas, Texas
●Kennedy Space Center(KSC)	Supporting Organization	NASA Center	Kennedy Space Center, Florida
●Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia
●Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama
●NASA Headquarters(HQ)	Supporting Organization	NASA Center	Washington, District of Columbia
Oklahoma State University-Main Campus	Supporting Organization	Academia	Stillwater, Oklahoma
University of Colorado Boulder	Supporting Organization	Academia	Boulder, Colorado
University of South Alabama	Supporting Organization	Academia	Mobile, Alabama
University of Vermont	Supporting Organization	Academia	Burlington, Vermont
University of Wisconsin-Madison	Supporting Organization	Academia	Madison, Wisconsin

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Co-Funding Partners	Type	Location
Naval Sea Systems Command(NAVSEA)	US Government	Washington, District of Columbia

Primary U.S. Work Locations	
Alabama	Colorado
District of Columbia	Florida
Maryland	Ohio
Oklahoma	Rhode Island
Texas	Vermont
Virginia	Wisconsin

Project Transitions

October 2013: Project Start

September 2015: Project canceled because merged or otherwise absorbed into another project

Rationale: Project canceled because merged or otherwise absorbed into another project

September 2015: Closed out

Closeout Summary: To request closeout information for this project, please send an email with the Subject "TechPort Closeout Report Request" to hq-aes@mail.nasa.gov and specify which project closeout report you are requesting.

Images

Exploration Augmentation Module (EAM) Concept
Conceptual Model of the Exploration Augmentation Module (EAM)
(https://techport.nasa.gov/image/3463)

Links

A Novel Approach for Engaging Academia in Collaborative Projects with NASA through the X-Hab Academic Innovation Challenge
(https://www.aiaa.org/meetingpapers/)

Design, Fabrication and Testing of a Smart Rail Prototype for the Deep Space Habitat Demonstrator
(http://ntrs.nasa.gov/search.jsp)

Design, Fabrication, and Testing of a Composite Rack Prototype in support of the Deep Space Habitat Program
(http://ntrs.nasa.gov/search.jsp)

Development of a Water Recovery System Resource Tracking Model
(http://arc.aiaa.org/series/6.ices)

Engineering Polymer Blends for Impact Damage Mitigation
(http://ntrs.nasa.gov/search.jsp)

Habitat Concepts for Deep Space Exploration
(https://www.aiaa.org/meetingpapers/)

NASA Habitat Demonstration Unit (HDU) Deep Space Habitat Analog
(https://www.aiaa.org/meetingpapers/)

Overview of Evolved Structural Prototypes in support of the Deep Space Habitat with Material and Sensor Strands Development
(http://ntrs.nasa.gov/search.jsp)

SLS-Derived Lab: Precursor to Deep Space Human Exploration
(https://www.aiaa.org/meetingpapers/)

Space Launch System Co-Manifested Payload Options for Habitation
(https://www.aiaa.org/meetingpapers/)